61-58.3
Surface Water Sources and Treatment

Regulation History as Published in State Register			
Date	Document Number	Volume	Issue
May 22, 1981	-	5	11
July 28, 1995	1830	19	7
May 24, 2002	2661	26	5

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A. Applicability.

This regulation applies to all new construction and all expansions or modifications of existing public water systems. If the Department can reasonably demonstrate that safe delivery of potable water to the public is jeopardized, a system may have to upgrade its existing facilities in order for an expansion or modification to meet the requirements of this regulation. This regulation prescribes minimum design standards for the construction of surface water intakes and treatment plants.

B. Surface Water Development.

(1) Quantity - Where the proposed source is to be the only source of water for the system, the quantity of water at the source shall:

(a) be adequate to meet the projected maximum daily water demand of the service area. For streams, the calculations shall be based on the lowest mean daily flow for the drought of record. For withdrawals from reservoirs, the calculation shall be based on the drought of record and shall also include requirements for other water uses in the reservoir and downstream;

(b) provide a reasonable surplus for twenty (20) years of anticipated growth;

(c) be adequate to compensate for all losses such as silting, evaporation, seepage, etc. and;

(2) Quality - An engineering evaluation shall be made considering all factors, both natural and man made, which will affect the quality of the source water. The evaluation shall include, but not be limited to:

(a) determining possible future uses of impoundments or reservoirs;

(b) determining degree of control of watershed by owner;

(c) assessing degree of hazard to the source from the accidental spillage of materials that may be toxic, harmful or detrimental to treatment processes;

(d) obtaining samples over a sufficient period of time to assess the microbiological, physical, chemical and radiological characteristics of the water;

(e) assessing the capability of the proposed treatment process to comply with the drinking water standards set forth in the Act and under R.61-58.5 , R.61-58.10, and R.61- 58.13.

(3) Intake Structures - The design of intake structures shall provide for:

(a) withdrawal of water from more than one level if quality varies with depth;

(b) separate facilities for release of less desirable water held in storage;

(c) capability for the cleaning of the inlet line;

(d) adequate protection against rupture by dragging anchors, etc.;

(e) inlet ports located above the bottom of the stream, lake or impoundment, but at sufficient depth to be kept submerged at low water levels;

(f) where shore wells are not provided, a diversion device capable of keeping large quantities of fish or debris from entering an intake structure;

(g) screens or gratings over the inlet to protect the pumps;

(h) a means for periodic cleaning of the screens or gratings;

(i) shore wells where necessary, which shall:

(i) have motors and electrical controls located above grade, and protected from flooding;

(ii) be accessible;

(iii) be designed against flotation;

(iv) be equipped with removable or traveling screens before the pump suction well;

(v) provide for introduction of chlorine or other chemicals in the raw water transmission main if necessary for quality control;

(vi) have intake valves and provisions for backflushing or cleaning by a mechanical device and testing for leaks, where practical; and,

(vii) have provisions for withstanding surges where necessary.

(4) Off-Stream Storage

(a) Reservoirs shall be constructed to ensure that water quality is protected by controlling runoff into the reservoir.

(b) Dikes must be structurally sound, constructed of low permeability material and protected against wind action and erosion. Vegetation and other unsuitable materials shall be removed from the dikes. Minimum dike width shall be eight (8) feet at the crest.

(c) The point of influent flow must be separated from the point of withdrawal to ensure turnover.

(5) Impoundments and Reservoirs - Unless specifically approved by the Department, the design of impoundments and reservoirs shall provide for:

(a) removal of brush, trees, and stumps to high water elevation;

(b) proper erosion control measures during construction; and,

(c) abandonment of all wells which will be inundated, in accordance with R.61- 58.2(B)(15).

(6) Raw Water Pumping Facilities

(a) The facility shall be elevated to a minimum of one (1) foot above the one hundred (100) year flood elevation, or protected to such elevation, shall be readily accessible at all times unless permitted to be out of service for the period of inaccessibility, shall be graded around the station so as to lead surface

drainage away from the station, and shall be protected to prevent vandalism and entrance by animals and unauthorized persons.

(b) The facility shall have adequate space for the installation of additional units if needed, and for the safe servicing of all equipment. The facility shall also be of durable construction, fire and weather resistant and with outward-opening doors.

(c) Pumping Equipment -

(i) At least two (2) pumping units shall be provided. The pumping facility shall be sized adequately to supply the full plant capacity with any pump out of service. The pumping units shall:

(A) Be driven by a prime mover able to operate against the maximum head and air temperature which may be encountered;

(B) Have spare parts and tools readily available, and,

(C) Be equipped with elapsed time hour meters for each pump or another acceptable mechanism to monitor run times.

(D) Be sized to operate from minimum to maximum pumping conditions without overloading the motor.

(ii) Suction lift shall be within allowable limits, preferably less than fifteen (15) feet and should be avoided if possible. If suction lift is necessary, provision shall be made for priming the pumps.

(iii) Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back-siphonage. When an air-operated ejector is used, the screened intake shall draw clean air from a point at least ten (10) feet above the ground or other source of possible contamination, unless the air is filtered by an apparatus approved by the Department. Vacuum priming may be used.

(iv) For pumps designed so that bearing lubrication fluids come into contact with the water being pumped, only water lubricated pumps may be used unless otherwise approved by the Department.

(d) Equipment Servicing - Pump facilities shall be designed so that proper maintenance of the equipment can be provided.

(e) Operator Access - Pump facilities shall be designed for easy access by stairs or ladders when necessary.

(f) Heating - In pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process.

(g) Ventilation - Ventilation shall conform to existing local, federal, and/or state codes. Adequate ventilation shall be provided for all pumping stations.

(h) Lighting - The facility shall be adequately lighted throughout. All electrical work shall conform to the requirements of the National Electric Code or applicable state and local codes.

(i) Water Seals - Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser

sanitary quality the seal shall be provided with a break tank or back-flow preventer. If a break tank is used, it shall be open to atmospheric pressure, have an air gap of at least six (6) inches or two (2) pipe diameters, whichever is greater, and be installed between the feeder line and the spill line of the tank. Where a back-flow preventer is used, it shall be a reduced pressure principle back-flow type installed in the feed line.

(j) Controls - Pumps, their prime movers and accessories, shall be controlled in such a manner that they will operate at rated capacity without dangerous overload. Where two or more pumps are installed, provision shall be made for alternation. Provision shall be made to prevent energizing the motor in the event of a backspin cycle. Electrical controls shall be located above grade.

(k) Water Pre-lubrication - When automatic pre-lubrication of pump bearings is necessary and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved bypass around the automatic control so that the bearings can, if necessary, be lubricated manually before the pump is started.

C. General Design Requirements.

(1) Plant Layout - Design shall provide for adequate access roads, site drainage, protection of basins from spillage (including during delivery of chemical shipments), and adequate protection from vandalism. Consideration shall also be given to functional aspects of the plant layout and future expansion.

(2) Building layout - Design shall provide for adequate ventilation, lighting, telephone service, heating and air conditioning, floor drainage, and, if necessary, dehumidification equipment. Consideration shall also be given to accessibility of equipment for operation, servicing, and removal, telephone communication capability, flexibility of operation, operator safety, and convenience of operation (filters, basins, etc. visible to the operator).

(3) Electrical controls - Main switch gear electrical controls shall be located above grade and be protected from standing water.

(4) Auxiliary Power - Where elevated storage equals less than one half maximum daily demand, portable or in-place auxiliary power shall be provided for all systems serving three hundred (300) or more service connections. An air quality permit may be required for the emissions from the auxiliary generators. Auxiliary power requirements may be waived if one or more of the following are applicable:

(a) A verifiable history of worst case power outages and verification that the available elevated storage can provide for a similar time period of outage.

(b) Two (2) or more independent sources from the serving electrical utility are available. or,

(c) An alternate water source is available via connections with other systems.

Auxiliary power shall be sized to provide for sufficient pumping and treatment capacity to meet one half (½) of the maximum daily demand or to supplement the existing storage to meet one half (½) of the maximum daily demand.

(5) Sample taps - Sample taps shall be provided so that representative water samples can be obtained from:

(a) each raw water source;

(b) appropriate locations throughout the treatment process so that the operator can maintain proper control of the treatment process;

(c) effluent from each filter and the combined filter effluent prior to any post chemical addition; and,

(d) the entry point(s) to the distribution system.

Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads. Taps shall not be of the mixing type, and shall not have a screen, aerator, or other such appurtenances.

(6) Monitoring Equipment

(a) Complete bacteriological and wet chemistry testing equipment is required for all surface water plants for daily monitoring of raw, coagulated, settled, filtered and finished water quality.

(b) Laboratory equipment and facilities shall be compatible with the raw water source, the intended use of the treatment plant and the complexity of the treatment process involved. Plants treating surface water shall have as a minimum the capability to monitor turbidity, appropriate disinfectant residual, pH, temperature, alkalinity, calcium hardness, and if added, fluoride, total phosphate or orthophosphate and silica.

(7) Plant Water - The treatment plant water service line and the plant finished water sample tap shall be supplied from a source of finished water at a point where all chemicals have been thoroughly mixed.

(8) Wall Castings - Consideration shall be given to providing extra wall castings built into the structure to facilitate future uses whenever pipes pass through walls of concrete structures.

(9) Flow Meters - Flow meters shall be provided for measuring raw and finished water, all backwash water, and where deemed necessary, other internal water uses at all surface water plants. Meters shall measure an instantaneous flow and have the capability to measure totalized flow.

(10) Piping Identification - To facilitate identification of piping in treatment plants and pumping stations, all pipes shall be color coded and marked with the name of the liquid or gas being carried and its direction of flow.

(11) Proprietary Treatment Units/ Innovative Treatment Techniques - Proprietary treatment units and alternative treatment technology may be considered if pilot tests demonstrate the ability of the technology to provide water which meets all drinking water standards utilizing the proposed raw water source. If the plant is permitted at rates which exceed the unit process rates specified in R.61-58.3(D), the system shall submit operating data within eighteen (18) months which justify continued operation at the higher rates. From the review of these data, the Department may revise the permitted treatment rate.

(12) Manuals and Parts Lists - An operation and maintenance manual shall be provided for each treatment plant. This manual shall, at a minimum, include repair information, parts lists for each piece of equipment, and procedures for the start up and shut down of the plant including all necessary chemical treatment systems.

(13) Safety - All design must meet applicable safety codes and minimum Occupational Safety and Health Administration (OSHA) standards.

D.Surface Water Treatment.

(1) Presedimentation - Presedimentation basins, where used, shall be designed such that:

(a) incoming water is dispersed across the full width of the line of travel;

(b) short circuiting shall be prevented; and,

(c) provisions for bypassing presedimentation basins are included.

(2) Conventional Sedimentation

(a) Rapid Mix - The rapid mix shall be designed so as to ensure the rapid dispersion of chemicals throughout the water to be treated.

(i) Mechanical Mixer - The mechanical mixer shall have sufficient horsepower to provide adequate dispersion of treatment chemicals and be equipped with variable speed drive.

(ii) Location - The rapid mix and flocculation basins shall be as close together as possible.

(iii) In-line mixers must be specifically approved by the Department, and shall be designed based on manufacturers recommendation and studies using the raw water source. In-line mixers shall be accessible without excavation.

(iv) A by-pass around the rapid mix or in-line mixers is prohibited.

(b) Flocculation - A minimum of two (2) parallel flocculation basins are required.

(i) Conventional Basin Design - Inlet and outlet design shall prevent short circuiting and destruction of floc. A drain or pumps shall be provided to handle de-watering and sludge removal.

(ii) Detention - The flow through velocity shall not be less than five tenths (0.5) nor greater than one and one half (1.5) feet per minute with detention time for floc formation of at least thirty (30) minutes.

(iii) Equipment - Multi-stage agitators shall be provided. The velocity gradient (G) shall decrease with each stage. G values shall be in the range of five (5) to one hundred (100) second ^{2}-1.

(iv) Piping - Flocculation and sedimentation basins shall be as close together as possible. The velocity of flocculated water through pipes and conduits to settling basins shall not be less than five tenths (0.5) nor greater than one and one half (1.5) feet per second. Allowances shall be made to minimize turbulence at bends and changes in direction

(v) Other designs - Baffling may be used to provide flocculation in small plants only after consultation with the Department. The design shall be such that the velocities and flows noted above will be maintained.

(c) Sedimentation - A minimum of two (2) sedimentation basins are required.

(i) Detention time - Sedimentation basin design considerations and calculations shall include basin overflow rate, weir loading rate, flow through velocity and theoretical detention time. For conventional

sedimentation basins with detention times of less than four (4) hours, an acceptable alternate basis for design must be provided and must be approved by the Department.

(ii) Inlet Devices - Inlets shall be designed to distribute water equally and at uniform velocities. The structures shall be designed so as to dissipate inlet velocities and provide uniform flows across the basin.

(iii) Outlet Devices - Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short circuiting.

(iv) Outlet Flow Rate - The approach velocity at the outlet weir shall be such that the resuspension of floc is minimized.

(v) Velocity - The velocity through settling basins shall not exceed five tenths (0.5) of a foot per minute, except as specifically approved by the Department. The basins shall be designed to minimize short circuiting. Baffles shall be provided, as necessary.

(vi) Overflow - An overflow weir (or pipe) shall be installed which will establish the maximum water level desired on top of the filters. It shall overflow at a location observable to the operator.

(vii) Drainage - Basins shall be provided with the means for draining, either by gravity or pumps. The amount of time required to drain the basin shall not be such that it interferes with plant operation.

(viii) Sludge handling - Facilities are required by the Department for the disposal of sludge and shall be designed in accordance with R.61-58.3(F). Provisions shall be made for the operator to observe and sample sludge being withdrawn from the basin.

(ix) Washdown Hydrants - Washdown hydrants shall be provided and shall be equipped with backflow prevention devices acceptable to the Department.

(3) Solids Contact Clarification - A minimum of two (2) solids contact units are required unless continuous sludge withdrawal is provided.

(a) Chemical Feed - Chemicals shall be applied at such points and by such means as to ensure satisfactory mixing of the chemicals with the water.

(b) Mixing - Rapid mix device or chamber ahead of the solids contact unit may be required by the Department to assure proper mixing of the chemicals applied. Mixing devices employed shall be so constructed as to provide adequate mixing of the raw water with previously formed sludge particles, and prevent deposition of solids in the mixing zone.

(c) Flocculation - Flocculation Equipment shall:

(i) have variable speed drive;

(ii) provide for coagulation to occur in a separate chamber or baffled zone within the unit; and,

(iii) provide the flocculation and mixing period to be not less than thirty (30) minutes, except as approved by the Department.

(d) Sludge removal - Sludge removal design shall provide that:

(i) sludge pipes shall not be less than three (3) inches in diameter and shall be arranged so as to facilitate cleaning;

(ii) entrance to sludge withdrawal piping shall be designed to prevent clogging;

(iii) valves shall be located outside the tank for accessibility;

(iv) the operator may observe and sample sludge being withdrawn from the unit; and,

(v) blowdown processes are automated.

(e) Sludge handling - Facilities are required by the Department for the disposal of sludge and shall be designed in accordance with R.61-58.3(F).

(f) Cross-connections

(i) Blow off outlets and drains shall terminate with proper air gap discharge at a location satisfactory to the Department.

(ii) Cross-connection control shall be included for the potable water lines used to backflush sludge lines.

(g) Detention time - The detention time shall be established on the basis of raw water characteristics and other local conditions that affect the operation of the unit.

Design considerations and calculations shall include theoretical detention time, weir loading rate, and surface loading rate.

(h) Weirs or orifices - The units shall be equipped with either overflow weirs or orifices.

(i) Weirs shall be adjustable, and at least equivalent in length to the perimeter of the tank. They shall be constructed so that water at the surface does not travel over ten (10) feet horizontally to the collection trough.

(ii) Weir loading shall not exceed fifteen (15) gallons per minute per foot of weir length for units used for softeners or clarifiers removing heavy alum floc (high turbidity raw water), or ten (10) gallons per minute per foot of weir length for units used for clarifiers removing light alum floc (low turbidity raw water).

(iii) Weirs or orifices shall produce uniform rising rates over the entire area of the tank.

(iv) Where orifices are used, the loading per foot shall be equivalent to specified weir loadings.

(i) Overflow rates - Unless supporting data is submitted to the Department the following rates shall not be exceeded:

(i) One and seventy-five hundredths (1.75) gallons per minute per square foot of area at the slurry separation line, for units used for softeners; and,

(ii) One (1.0) gallon per minute per square foot of area at the sludge separation line for units used for turbidity removal.

(4) Tube or Plate Settlers - Pilot test data is required prior to approval of settler units. The pilot tests must demonstrate that the unit is capable of treating the source water to comply with all drinking water standards during the worst conditions of raw water quality.

(a) Inlet and outlet considerations - Inlet and outlet devices shall be designed such that proper settling velocities are maintained and short circuiting is minimized.

(b) Drainage - Drain piping from the settler units shall be sized to facilitate a quick flush of the settler units, and to prevent flooding of the other portions of the plant.

(c) Application rate for tubes - A maximum rate of two (2) gallons per minute per square foot of cross-sectional area is allowed for tube settlers, unless pilot or full scale demonstration testing indicate that higher rates do not adversely affect water quality.

(d) Application rates for plates - A maximum plate loading rate of five tenths (0.5) gallons per minute per square foot, based on eighty (80) percent of the projected horizontal plate area is allowed, unless pilot or full scale demonstration testing indicate that higher rates do not adversely affect water quality.

(e) Flushing lines - Flushing lines shall be provided to facilitate maintenance, and shall be properly protected against backflow and back siphonage.

(5) Filtration - The following criteria applies to both conventional down-flow filters and to up-flow filters. All filters treating surface water must meet the performance standards set forth in R.61-58.10(E).

The application of any one type of filtration must be supported by water quality data representing a reasonable period of time to characterize the variations in water quality. Experimental treatment studies may be required to demonstrate the applicability of the method of filtration proposed. The maximum loss of head should be designed to occur at the point of terminal filter turbidity increase.

(a) Rapid Rate Gravity Filters

(i) Pretreatment - The use of rapid rate gravity filters shall require pretreatment.

(ii) Number - At least two (2) units shall be provided. Provisions shall be made to assure continuity of service with a filter unit temporarily removed from operation. The plant shall be designed so that the design filtration rate is not exceeded during backwash operations. In addition, provisions shall be made so that hydraulic surges through the filters are minimized during flow rate changes and when filters are removed from service for backwashing.

(iii) Rate of Filtration - The rate of filtration shall be determined through considerations of such factors as the quality of the raw water, the degree of pretreatment provided, the filter media provided and other considerations required by the Department. The nominal rate shall be four (4) gallons per minute per square foot of filter area except as higher rates are justified by the professional engineer to the satisfaction of the Department.

(iv) Structural Details and hydraulics - The filter structure shall be designed to provide:

(A) vertical walls within the filter;

(B) no protrusion of the filter walls into the filter media;

(C) head room to permit normal inspection and operation;

(D) access to at least fifty (50) percent of the perimeter.

(E) minimum depth of filter of eight and one half (8- ½) feet measured from the top of the underdrain to the top of the filter bay;

(F) If a filter is designed to operate to a specified loss of head then the filter shall be designed with that water level or greater above the surface of the filter media;

(G) trapped effluent to prevent backflow of air to the bottom of the filters;

(H) prevention of floor drainage to the filter with a minimum four (4) inch curb around the filters;

(I) maximum influent velocity of treated water in pipes and conduits to filters of two (2) feet per second;

(J) cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy, or following lime-soda softening;

(K) washwater drain capacity to carry maximum backwash flow;

(L) walkways around filters, to be not less than twenty-four (24) inches wide;

(M) safety handrails or walls around filter areas adjacent to walkways; and,

(N) no roof drainage into the filter or basins and conduits preceding the filters.

(v) Washwater Troughs - Washwater troughs shall be designed to provide:

(A) the bottom elevation of the trough must be above the maximum level of expanded media during washing;

(B) a two (2) inch freeboard at the maximum rate of wash;

(C) the top or edge to be level;

(D) spacing so that each trough serves the same number of square feet of filter area; and,

(E) maximum horizontal travel of suspended particles to reach trough not to exceed three (3) feet.

(vi) Filter Material - One or more of the following filter media shall be used and shall have a depth of at least thirty (30) inches.

(A) Anthracite - Clean crushed anthracite, or a combination of anthracite and other media may be considered. If used alone, the anthracite shall have an effective size of 0.45 millimeters to 0.7 millimeters and a uniformity coefficient of not less than 1.3 nor greater than 1.65. If used in conjunction with sand or

other media, the anthracite shall have an effective size of 0.45 millimeters to 1.2 millimeters and a uniformity coefficient of not less than 1.3 nor greater than 1.85.

(B) Sand Media - Sand media shall have an effective size of 0.45 millimeters to 0.55 millimeters, and a uniformity coefficient of not less than 1.3 nor greater than 1.65.

(C) Granular Activated Carbon - Use of granular activated carbon media, if used alone, may be considered only with approval of the Department, and must meet the requirements for anthracite media. There shall be provision for a free chlorine residual in the water following the filters and prior to distribution. There must be a means for periodic treatment of filter material for control of bacteria and other growths, and there must be provisions for testing, regeneration, and periodic replacement of the carbon.

(D) Torpedo Sand - A three (3) inch layer of torpedo sand shall be used as a supporting media for the filter sand. Such torpedo sand shall have an effective size of 0.8 millimeters to 2.0 millimeters, and a uniformity coefficient not less than 1.3 nor greater than 1.7 millimeters.

(E) Gravel - Gravel, when used as the supporting media, shall consist of hard, rounded particles and shall not include flat or elongated particles. The coarsest gravel shall be 2.5 inches in size when the gravel rests directly on the strainer system, and shall extend above the top of the perforated laterals or strainer nozzles. The size and depth of gravel required is dependent upon the type of underdrain used. Size and depth of gravel required when using proprietary filter bottoms shall be in accordance with the manufactures recommendations.

(F) Other Filter Media Design - Other filter media design will be considered based on pilot test data and operating experience.

(vii) Filter Bottoms and Strainer Systems

(A) All filter bottom and strainer systems shall be designed to ensure both an even distribution of washwater with minimum head loss and a uniform rate of filtration.

(B) The design of manifold type collection systems shall be to provide the ratio of the area of the final openings of the strainer system to the area of the filter of 0.003; provide the total cross-sectional area of the laterals of twice the total area of the final openings; and provide the cross-sectional area of the manifold at one and one half (1.5) to two (2) times the total area of the laterals.

(C) Proprietary bottoms shall be permanently grouted or fastened in place.

(D) Porous plate bottoms shall not be used where iron or manganese may clog them or with waters treated with lime prior to filtration.

(viii) Surface Wash or Subsurface Wash - Surface wash or subsurface wash facilities shall be required for all filters treating surface water, unless an air scouring system is provided, and may be accomplished by a system of fixed nozzles or a revolving type apparatus. All surface wash or subsurface wash devices shall be designed with:

(A) provisions for water pressures of at least forty-five (45) pounds per square inch;

(B) a properly installed vacuum breaker or other approved device to prevent back siphonage; and,

(C) a rate of flow of two (2) gallons per minute per square foot of filter area with fixed nozzles or one half (0.5) gallons per minute per square foot with revolving arms.

(ix) Air Scouring - Air scouring may be used in lieu of or in conjunction with surface or subsurface wash, and is recommended for filtration rates greater than four (4) gallons per minute per square foot. The air scouring system shall be designed such that:

(A) air flow shall be three (3) to five (5) standard cubic feet per minute per square foot of filter area when the air is introduced in the underdrain; a lower rate must be used when the air scour distribution system is placed above the underdrain;

(B) excessive loss of filter media during backwashing is avoided;

(C) it is followed by a fluidization wash which is sufficient to restatify the media;

(D) the air supply remains free from contamination;

(E) clogging of the air scour nozzles and the entering of the media into the air scour distribution system is avoided;

(F) air delivery piping does not pass down through the filter media; and,

(G) regular maintenance and/or replacement of the air delivery piping may be performed.

(x) Appurtenances - Each filter shall have:

(A) sampling taps for filtered water, backwash water and rewash water;

(B) an indicating loss of head gauge;

(C) indicating flow rate control. Equipment that simply maintains a constant water level on the filters is not acceptable, unless the rate of flow onto the filter is properly controlled;

(D) provisions for filtering water to waste with a properly installed vacuum breaker or other approved device for backflow prevention;

(E) continuous recording device or computer data for loss of head and rate of flow instrumentation; and,

(F) continuous turbidity monitoring equipment for raw and settled water. Each filter shall be equipped with a continuous, on-line turbidimeter. The filter effluent turbidimeters shall be nephelometric type and equipped with alarms to be set to enunciate at five tenths (0.50) nephelometric turbidity units. Continuous recorders or computer data which record at no greater than fifteen (15) minute intervals are required for each unit.

(xi) Backwash - Provisions shall be made for washing filters as follows:

(A) A minimum rate of fifteen (15) gallons per square foot per minute, consistent with water temperatures and specific gravity of the filter media or a rate necessary to provide for a fifty (50) percent expansion of the filter bed is required.

(B) Filtered water shall be provided at the required rate by washwater tanks, a washwater pump, from the high service main, a combination of these, or by other means acceptable to the Department;

(C) Washwater pumps in duplicate are required unless an alternate means of obtaining washwater is available;

(D) Capacity for at least twenty (20) minute wash of one filter is required at the design rate of wash;

(E) A washwater regulator or valve on the main washwater line to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide;

(F) A rate-of-flow indicator, preferably with a totalizer, is required on the main washwater line, and shall be located so that it can be easily read by the operator during the washing process;

(G) The design shall prevent rapid changes in backwash water flow; and,

(H) A treatment of filter backwash designed in accordance with R.61-58.3 (F) shall be provided.

(b) High Rate Gravity Filters - No rates above four (4) gallons per minute per square foot will be considered without full scale pilot tests of at least twelve (12) month duration. High rate approval will not be considered for a plant with a flashy raw water source unless adequate off-stream storage is provided. High rate approval for existing plants requires an engineering evaluation and will be approved only where a sufficient number of experienced and qualified operators are employed. Where high rate approval will not allow a plant to maintain minimum unit process detention times specified in R.61-58.3.D(2), evaluations of those unit processes must be included in the pilot test and high rate engineering evaluation. The design of high rate gravity filters shall be in accordance with all applicable requirements of R.61-58.3.D(5).

(c) Rapid Rate Pressure Filters - Pressure filters will not be allowed as primary filtration on surface waters.

(d) Diatomaceous earth filtration will not be allowed as primary filtration on surface waters.

(i) Conditions of use - Diatomaceous earth filters are expressly excluded from consideration for bacteria removal, color removal, or turbidity removal where either the gross quantity of turbidity is high or the turbidity exhibits poor filterability characteristics, and filtration of waters with high algae counts.

(ii) Pilot plant study - Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated.

(A) Conditions of the study such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, etc., shall be approved by the Department prior to the study.

(B) Satisfactory pilot plant results shall be obtained prior to preparation of final construction plans and specifications.

(C) The pilot plant study shall demonstrate the ability of the system to meet applicable drinking water standards at all times.

(iii) Types of filters - Pressure or vacuum diatomaceous earth filtration units will be considered for approval.

(iv) Treated water storage - Treated water storage capacity in excess of normal requirements shall be provided to allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate, and guarantee continuity of service during adverse raw water conditions without by-passing the system.

(v) Number of filtration units - At least two (2) units shall be provided.

(vi) Precoat - A uniform precoat of at least 1/16 inch shall be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing either a filter-to-waste or recirculation system.

(vii) Body feed - A body feed system to apply additional amounts of diatomaceous earth slurry during the filter run is required. Continuous mixing of the body feed slurry shall be provided.

(viii) Filtration

(A) Rate of filtration - The filtration rate shall be controlled by a positive means and shall not exceed one and a half (1.5) gallons per minute per square foot of filter.

(B) Head loss - The head loss shall not exceed thirty (30) pounds per square inch for pressure diatomaceous earth filters, or a vacuum of fifteen (15) inches of mercury for a vacuum system.

(C) Recirculation - A recirculation or holding pump shall be employed to maintain differential pressure across the filter when the unit is not in operation in order to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of one tenth (0.1) gallon per minute per square foot of filter area shall be provided.

(D) Septum or filter element - The filter elements shall be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and shall be spaced such that no less than one (1) inch is provided between elements or between any element and a wall.

(E) Inlet design - The filter influent shall be designed to prevent scour of the diatomaceous earth from the filter element.

(ix) Backwash - A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided. Treatment is required for the backwash water and shall be designed in accordance with applicable portions of R.61-58.3 (F).

(x) Appurtenances - The following shall be provided for every filter:

(A) sampling taps for raw and filtered water;

(B) loss of head or differential pressure gauge;

(C) rate-of-flow indicator, with totalizer;

(D) a throttling valve used to reduce rates below normal during adverse raw water conditions; and,

(E) an evaluation of the need for body feed, recirculation, and any other pumps, in accordance with R.61-58.4(B)(1)(d).

(xi) Monitoring - A continuous monitoring turbidimeter with recorder is required on the filter effluent.

(e) Direct Filtration - The use of direct filtration technology will be considered only where sufficient raw water quality and engineering data is submitted to justify such. No rates above four (4) gallons per minute per square foot will be considered without full scale pilot tests of at least twelve (12) month duration. The following shall be met for direct filtration approval:

(i) Off stream raw water storage must be provided, unless a consistent raw water quality can be demonstrated to the satisfaction of the Department.

(ii) The flocculation chamber design shall be based on pilot plant studies in conjunction with applicable portions of R.61-58.3(D)(2).

(iii) Each filter must meet the basic requirements of a rapid rate gravity filter as given in R.61-58.3(D)(5).

(iv) Filters shall be provided with either rapid rate dual or mixed media specified for filtration rates of four (4) gallons per minute per square foot or greater.

(v) Surface wash, subsurface wash and/or air scour facilities designed in accordance with R.61-58.3(D)(5)(a)(viii) and R.61-58.3(D)(5)(a)(ix) for each filter.

(vi) Each direct filtration plant shall have continuous turbidity monitoring equipment for raw and settled water. Each filter shall be equipped with a continuous, on-line turbidimeter. The filter effluent turbidimeters shall be nephelometric type and equipped with alarms set to enunciate at five tenths (0.50) nephelometric turbidity units. Continuous recorders or computer data are required for each unit.

(vii) Continuous recording devices may be required for loss of head and rate of flow instrumentation.

(viii) Provisions for filtration to waste with appropriate measures for backflow prevention are required.

(6) Disinfection - Disinfection may be accomplished with gas chlorine, chlorine dioxide, ozone or chloramines. Other agents will be considered by the Department provided that reliable feed equipment is available and test procedures for a residual are recognized, and the agent meets the requirements of an acceptable drinking water additive. Continuous disinfection will be required at all surface water supplies. Due consideration shall be given to the contact time of the disinfectant in water with relation to pH, ammonia, taste-producing substances, temperature, bacterial quality, and other pertinent factors. Consideration also must be given to the formation of disinfection by-products and meeting the contact times prescribed in R.61-58.10.

(a) Chlorination - Where chlorine is used the following shall apply:

(i) Type - Only vacuum type gas chlorinators are acceptable.

(ii) Capacity - The chlorinator capacity shall be such that a free chlorine residual of at least five (5) milligram per liter can be attained in the water after a contact time of at least thirty (30) minutes at maximum flow rates. The equipment shall be of such design that it will operate accurately over the desired feeding range.

(iii) Number of units - at least one (1) backup chlorinator shall be provided in addition to the number required for each primary feed point. The backup chlorinator shall be equal to the capacity of the largest chlorinator in use.

(iv) Automatic Proportioning - Automatic proportioning chlorinators will be required where the rate of flow or chlorine demand is not reasonably constant or where the rate of flow of the water is not manually controlled.

(v) Residual Chlorine - Where alternate disinfectants are used in the treatment process, the capability for the addition of either free or combined chlorine in the finished water shall be provided. Residual chlorine must be sufficient to meet the applicable requirements of R.61-58.10.

(b) Cross connection protection - The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply by sources of questionable quality.

(c) Chlorine gas - Consideration shall be given to the location of gas chlorine facilities and the safety of the public in the surrounding area. Consideration may be given for facilities that propose the use of chlorine gas in inhabited areas when the use of safety devices which will not allow the release of chlorine gas (e.g. chlorine scrubbers) are provided. Only vacuum gas chlorinator systems will be approved.

(i) Chlorine gas feed shall be enclosed and separated from other operating areas. Concrete, wood, and other construction materials shall be sealed to prevent the escape of chlorine gas from the chlorine building. The chlorine room shall be provided with a shatter resistant inspection window installed in an interior wall or an inspection window in the door. It shall be constructed in such a manner that all openings between the chlorine room and the remainder of the plant are sealed, and shall be provided with doors ensuring ready means of exit and opening only to the building exterior.

(ii) Full and empty cylinders of chlorine gas shall be isolated from operating areas, restrained in position to prevent upset, stored in rooms separate from ammonia storage, and stored in areas not in direct sunlight or exposed to excessive heat.

(iii) If the chlorine room is large enough for a person to enter, the room shall be constructed such that:

(A) It has a ventilating fan with a capacity which provides one complete air change per minute;

(B) The ventilating fan shall be located near the ceiling and pull suction through a duct extending to within twelve (12) inches of the floor and discharge as far as practical from the door and air inlet. The point of discharge shall be located so as not to contaminate air inlets to any rooms or structures. A sealed motor or other means shall be used to ensure the reliability of the fan;

(C) Air inlets shall be located near the ceiling;

(D) Air inlets and outlets shall have mechanical louvers;

(E) Switches for fans and lights are outside of the room, at the entrance;

(F) Vents from feeders and storage areas discharge to the outside atmosphere, above grade and away from inlet vent; and,

(G) Ventilation shall not be automatically controlled.

(iv) If the room is too small for a person to enter, the room must meet only R.61-58.3(D)(2)(c)(iii)(E) and (F).

(v) Chlorine feed lines shall meet the following requirements:

(A) Chlorine gas under pressure shall be piped with schedule eighty (80) stainless steel or schedule eighty (80) seamless carbon steel. No chlorine gas under pressure will be piped beyond the chlorinator room.

(B) Chlorine gas under vacuum shall be piped with schedule eighty (80) PVC or reinforced fiberglass.

(C) Chlorine solution shall be piped with schedule eighty (80) PVC.

(vi) Heaters shall be provided to maintain proper temperature for operation.

(vii) There shall be no equipment housed in the chlorine room except chlorinators, chlorine cylinders, weighing scales, heater, ventilation fan, and light(s).

(viii) Weighing scales shall be provided for weighing cylinders, at all installations utilizing chlorine gas unless provisions for automatic switchover of cylinders and an acceptable alternate means to determine daily dosage are provided.

(ix) Chlorine feed systems shall be designed to ensure continuous feed of chlorine.

(x) If a floor drain is provided, it shall be equipped with a water seal or trap to prevent escaped gases from exiting through the building sewer.

(xi) A chlorine leak detection and alarm system shall be provided.

(d) Ozone - Ozone is a suitable disinfectant for surface water. When used as a pre- treatment chemical for surface water, provisions shall be made for post chlorination or chloramination. Consideration shall be given to potential algae growth, removal of assimilated carbon from treated waters, and the formation of oxidized organics. On-site generation facilities shall be constructed in accordance with manufacturer's standards.

(i) Pilot plant tests - Pilot plant tests shall be performed with the water to be treated to establish the optimum dosage, contact time, depth of conductor and the need for multiple application points.

(ii) Number of Units - At least two (2) generators shall be provided. The facility shall be adequately sized to provide the maximum treatment capacity with one generator out of service.

(iii) Building Design - Ozone generators shall be housed in a separate room with separate heating and ventilation. The building layout must provide for easy access to the equipment. Ventilation equipment shall be two (2) speed with the normal speed providing the normal distribution of heat or air movement.

The second speed must be capable of providing a complete turnover of the air in the room every two (2) minutes to exhaust any ozone leakage in an emergency.

(iv) Piping Materials

(A) All dry ozone gas piping shall be mechanical jointed number 304 or 316 stainless steel or welded 304L or 316L stainless steel. All wet ozone gas piping shall be number 316 or 316L stainless steel. All flexible couplings shall be stainless steel.

(B) Valves shall be stainless steel face and body.

(C) Gasket materials shall be resistant to deterioration by the ozone.

(v) Reinforced concrete or stainless steel are acceptable materials. All concrete joints shall be sealed using a synthetic rubber material resistant to deterioration by ozone.

(e) Other disinfection agents - Any proposal for the use of other disinfecting agents shall be approved by the Department prior to preparation of final plans and specifications.

(f) Ammonia Gas - Consideration shall be given to the location of ammonia gas facilities and the safety of the public in the surrounding area. Only vacuum ammonia systems will be approved.

(i) Ammonia gas feed shall be enclosed and separated from other operating areas. Concrete, wood, and other construction materials shall be sealed to prevent the escape of ammonia gas from the room. The ammonia room shall be provided with a shatter resistant inspection window installed in an interior wall or an inspection window in the door. It shall be constructed in such a manner that all openings between the ammonia room and the remainder of the plant are sealed, and shall be provided with doors ensuring ready means of exit and opening only to the building exterior.

(ii) Full and empty cylinders of ammonia gas shall be isolated from operating areas, restrained in position to prevent upset, stored in rooms separate from chlorine storage, and stored in areas not in direct sunlight or exposed to excessive heat.

(iii) If the ammonia room is large enough for a person to enter, the room shall be constructed such that:

(A) It has a ventilating fan with a capacity which provides one complete air change per minute;

(B) The ventilating fan shall be located and pull suction near the ceiling and discharge as far as practical from the door and air inlet. The point of discharge shall be located so as not to contaminate air inlets to any rooms or structures. A sealed motor or other means shall be used to ensure the reliability of the fan;

(C) Air inlets shall be located near the floor;

(D) Air inlets and outlets shall have mechanical louvers;

(E) Switches for fans and lights are outside of the room, at the entrance;

(F) Vents from feeders and storage areas discharge to the outside atmosphere, above grade and away from inlet vent; and,

(G) Ventilation shall not be automatically controlled.

(iv) If the room is too small for a person to enter, the room must meet only R.61-58.3(D)(2)(f)(iii)(E), and (F).

(v) Ammonia feed lines shall not carry ammonia gas beyond the ammonia room.

(vi) There shall be no equipment housed in the ammonia room except ammoniators, ammonia cylinders, weighing scales, heater, ventilation fan, and light(s).

(vii) Weighing scales shall be provided for weighing cylinders, at all plants utilizing ammonia gas from cylinders. Where bulk storage tanks are installed, they shall be equipped with a pressure gauge.

(g) Chlorine Dioxide - Chlorine Dioxide is a suitable disinfectant for surface water. Chlorine dioxide shall be generated on site. The unit shall be flow paced and not have a holding tank for the chlorine dioxide solution generated. All applicable EPA disinfectant by-product rules shall be observed.

(i) Sizing of the chlorine dioxide generator - Chlorine dioxide demand studies shall be conducted to determine estimated feed rates and points of feed.

(ii) Building Design -

(A) Chlorine dioxide generators shall be located in a room separate from chlorine cylinders.

(B) Number of Units: Where chlorine dioxide is used as the primary disinfectant, at least two (2) flow pacing chlorine dioxide generators shall be provided. The facility shall be adequately sized to supply the maximum treatment capacity with any one generator out of service. If chlorine dioxide is not used as a primary disinfectant (i.e. an oxidant only), a second generator is not required.

(iii) Piping Materials -

(A) All piping from the chlorine dioxide generator shall be schedule 80 PVC.

(B) Gasket materials shall be kynar or other compatible material.

(C) All tubing connector fittings shall be kynar or other compatible material.

(7) Aeration - Aeration treatment devices, as described herein, may be used for oxidation, separation of gases or for taste and odor control.

(a) General Requirements

(i) Sample taps must be provided following aeration equipment.

(ii) Where aeration equipment discharges directly to the distribution system, air release valves must be provided.

(b) Natural Draft Aeration - Design shall provide that:

(i) Water is distributed uniformly over the top tray;

(ii) Water is discharged through a series of three (3) or more trays with the separation of trays not less than twelve (12) inches;

(iii) Trays are loaded at a rate of one (1) gallon per minute to five (5) gallons per minutes for each square foot of total tray area;

(iv) Trays have slotted, woven wire cloth or perforated bottoms;

(v) Perforation are three sixteenth (3/16) to one-half (½) inches in diameter, spaced one (1) to three (3) inches on centers, when perforations are used in the distribution pan;

(vi) Construction of durable material resistant to the aggressiveness of the water and dissolved gases;

(vii) Protection of aerators from loss of spray water by wind carriage by enclosure with louvers sloped to the inside at an angle of approximately forty- five (45) degrees;

(viii) Protection from insects by number twenty-four (24) mesh screen; and,

(ix) Aerated water receives disinfection treatment.

(c) Forced or Induced Draft Aeration - Devices shall be designed to:

(i) Provide an adequate countercurrent of air through the enclosed aeration column;

(ii) Include a blower in a screened enclosure and with a watertight motor;

(iii) Exhaust air directly to the outside atmosphere;

(iv) Include a down-turned, number twenty-four (24) mesh screened air outlet and inlet;

(v) Be such that air introduced in the column shall be as free from noxious fumes, dust, and dirt as possible;

(vi) Be such that sections of the aerator can be easily reached or removed for maintenance of the interior;

(vii) Provide loading at a rate of one (1) to five (5) gallons per minute for each square foot of total tray area;

(viii) Ensure that the water outlet is adequately sealed to prevent the unwarranted loss of air;

(ix) Discharge through a series of five (5) or more trays, with separation of trays not less than six (6) inches;

(x) Provide distribution of water uniformly over the top tray; and,

(xi) Be of a durable corrosive resistant material.

(d) Pressure Aeration - This method may be used for oxidation purposes if pilot plant study indicates method is applicable. It is not acceptable for removal of dissolved gases. Filters following pressure aeration shall have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to give thorough mixing of compressed air with water being treated. Screened and filtered air, free of noxious fumes, dust, dirt and other contaminants shall be provided.

(e) Other Methods of Aeration - Other methods of aeration may be used if applicable to the treatment needs. Such methods may include, but are not restricted to, spraying, diffused air, cascades, and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated and shall be subject to Department approval.

(8) Fluoridation - Commercial sodium fluoride, sodium silicofluoride and hydrofluorosilic acid shall be NSF approved and shall conform to American Waterworks Association Standards B701, B702 and B703, respectively. Fluoride chemicals shall meet the requirements of chemical additives in R.61-58.2(E)(3). The proposed method of fluoride feed shall be approved by the Department prior to preparation of final plans and specifications.

(a) Fluoride Compound Storage - Dry chemical storage shall be designed in accordance with R.61-58.3.E(2)(e). Storage units for hydrofluorosilic acid shall be isolated from operating areas and shall be vented to the atmosphere at a point outside any building.

(b) Dry Conveyors - Provisions shall be made for the proper transfer of dry fluoride compounds from shipping containers to storage bins or hoppers, in such a way as to minimize the quantity of fluoride dust.

(c) Injection Point - The fluoride compound shall not be added before lime addition, to avoid precipitation of fluoride.

(d) Chemical Feed Installations - Fluoride feed systems shall meet the following criteria:

(i) Scales or loss-of-weight recorders for weighing the quantity of chemicals added shall be provided;

(ii) Feed equipment shall have an accuracy to within five (5) percent of any desired feed rate;

(iii) The point of application of hydrofluorosilic acid, if into a pipe, shall be in the lower half of the pipe and project upward at an angle approximately forty (40) degrees and extend into the pipe one-third of diameter; and,

(iv) All fluoride feed lines shall be provided with adequate antisiphon devices.

(v) All fluoride feed systems shall be equipped with a fail-safe system to prevent the continued feed of fluoride at times when there is no flow of water through the fluoride feed point.

(e) Protective equipment - At least one (1) pair of rubber gloves, a respirator of a type certified by the National Institute for Occupational Safety and Health for toxic dusts or acid gas (as necessary), an apron or other protective clothing, and goggles or face masks shall be provided for use by the operator. Other protective equipment may be required, as deemed necessary by the Department.

(f) Dust Control

(i) Provisions shall be made for the transfer of dry fluoride compounds from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of fluoride dust which may enter the room in which the equipment is installed. The enclosure shall be provided with an exhaust fan and dust filter to the outside atmosphere of the building.

(ii) Provisions shall be made for disposing of empty bags, drums and barrels in a manner which will minimize exposure to fluoride dusts. A floor drain shall be provided to facilitate the washing of floors.

(9) Corrosion Control - Water that is corrosive due either to natural causes or to treatment given the water shall be rendered non-corrosive, and nonaggressive before being pumped to the distribution system.

(a) Alkali Feed - Corrosive water due to natural occurrence, created by the addition of alum or other coagulant, shall be treated by an alkali feed. Alkali feed can consist of lime, soda ash, bicarbonate, caustic soda, or a combination of any of the above. Lime feed systems shall include a mechanism for flushing the feed lines, including suction and pumping equipment, if used.

(b) Phosphates - The feeding of phosphates may be applicable for corrosion control. Phosphate chemicals shall meet the requirements of chemical additives in R.61- 58.3(E)(3).

(c) Carbon dioxide addition

(i) Recarbonation basin design shall provide:

(A) a total detention time of at least twenty (20) minutes.

(B) two (2) compartments, each with a depth of eight (8) feet, consisting of a mixing compartment having a detention time of at least three (3) minutes, and a reaction compartment.

(ii) Adequate precautions shall be taken to prevent the possibility of carbon monoxide entering the plant from recarbonation compartments.

(iii) Provisions shall be made for draining the recarbonation basin and removing sludge.

(d) Other Treatment - Other treatment for controlling corrosive waters will be considered on a case by case basis. All chemicals must meet the requirements in R.61- 58.3(E)(3). Any proprietary compound must receive the specific approval of the Department before use.

(e) Control - Laboratory equipment, acceptable to the Department, shall be provided to test for the compounds being fed.

(10) Taste and Odor Control - Provision shall be made for the addition of taste and odor control chemicals at all surface water treatment plants. These chemicals shall be added sufficiently ahead of other treatment processes to ensure adequate contact time for an effective and economical use of the chemicals.

(a) Flexibility - Plants treating water that is known to have taste and odor problems shall be provided with equipment that makes several of the control processes available to allow the operator flexibility in operation.

(b) Chlorination - Chlorination can be used for the removal of some objectionable odors. Adequate contact time must be provided to complete the chemical reactions involved. Consideration shall be given to disinfection by-products if this method is used.

(c) Chlorine Dioxide - Chlorine dioxide may be used in the treatment of taste or odor. Provision shall be made for the proper storing and handling of sodium chlorite, so as to eliminate any danger of explosion. Consideration shall be given to disinfection by- products if this method is used.

(d) Powdered Activated Carbon - Where added, powder activated carbon feed systems shall meet the following criteria:

(i) Powdered activated carbon may be added prior to coagulation to provide maximum contact time, but shall not be added near the point of chlorine application.

(ii) Provisions shall be made for adequate dust control.

(iii) Provision shall be made for adding at least forty (40) milligrams per liter.

(e) Granular Activated Carbon Absorption Units - Rates of flow shall be consistent with the type and intensity of the problem. The rate used shall be supported by the results of pilot plant studies and shall be accordance with the requirements of R.61-58.3(D)(5).

(f) Copper Sulfate and Other Copper Compounds - Continuous or periodic treatment of water with copper compounds to kill algae or other growths shall be controlled to prevent copper in excess of one (1) milligrams per liter as copper in the plant effluent or distribution system. Care shall be taken in obtaining a uniform distribution. Department approval shall be obtained prior to the use of any such compound.

(g) Aeration - Aeration units used for taste and odor removal shall be designed in accordance with R.61-58.3(D)(7).

(h) Potassium Permanganate - The application of potassium permanganate may be considered, provided that dosages are determined by permanganate demand testing.

(11) Membrane Technology - All applications for projects involving membrane technology must be preceded by an engineering report and may require a pilot study. The engineering report must meet the requirements of R.61-58.1.C.

(a) General Requirements

(i) Membrane material - No membrane material shall be used in a public water system unless the material or product has been tested and certified as meeting the specifications of the American National Standard Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. This requirement shall be met under testing conducted by a third party product certification organization accredited for this purpose by the American National Standards Institute.

(ii) Loading rates must be determined by pilot testing and/or manufacturers recommendations.

(iii) Scale Inhibitors and Cleaning Solutions - Where required, scale inhibitors and cleaning solutions must meet the requirements of chemical additives R.61-58.3.E(3).

(b) Electrodialysis Reversal - Electrodialysis reversal treatment shall not be used on surface water or groundwater under the direct influence of surface water.

E. Chemical Application.

(1) General - No chemical shall be applied to treat drinking waters unless specifically approved by the Department.

(a) Plans and specifications - Plans and Specifications shall be submitted for review and approval, as required by in R.61-58.1, and shall include:

(i) descriptions of feed equipment, including maximum and minimum feed ranges and pump curves for solution feeders,

(ii) location of feeders, piping layout and points of chemical application;

(iii) storage and handling facilities;

(iv) specifications for chemicals to be used;

(v) operating and control procedures including proposed application rates;

(vi) descriptions of testing equipment and procedures; and,

(vii) locations of sampling taps for testing.

(b) Chemical application - Chemicals shall be applied to the water at such points and by such means as to:

(i) provide maximum efficiency of treatment;

(ii) ensure maximum safety to consumer;

(iii) provide maximum safety to operators;

(iv) ensure satisfactory mixing of the chemicals with the water;

(v) provide maximum flexibility of operation through various points of application, when appropriate,

(vi) prevent backflow or back-siphonage between multiple points of feed through the use of separate feed equipment for each point and backflow preventers where a manifold system is used for standby, multiple feed use;

(vii) provide a separate injection point and a separate feed line for each chemical application that is added and spacing to prevent inter-reaction of chemicals; and,

(viii) provide chemical injection points which are readily accessible. All below-grade injection points shall be housed in a vault or similar structure.

(c) General equipment design - General equipment design shall be such that:

(i) chemical-contact materials and surfaces are corrosion resistant;

(ii) corrosive chemicals are introduced in such a manner as to minimize potential for corrosion; and,

(iii) chemicals that are incompatible are not fed, stored or handled together.

(2) Facility Design

(a) Chemical feeders

(i) A separate feeder shall be used for each separate chemical applied, and for each injection point.

(ii) Spare parts shall be available for all feeders to replace parts which are subject to wear and damage.

(iii) Dry chemical feeds shall:

(A) measure chemicals volumetrically or gravimetrically;

(B) provide adequate solution water and agitation of the chemical in the solution pot;

(C) provide gravity feed from solution pots; and,

(D) completely enclose chemicals to prevent emission of dust into the operating room and/or provide dust collection units.

(iv) When a booster pump is required, duplicate equipment shall be provided; and, when necessary, standby power shall be provided. Where chemical feed is necessary for the protection of the supply, such as chlorination, coagulation, or other essential processes:

(A) A minimum of two (2) feeders shall be provided; and,

(B) The standby unit or a combination of units of sufficient capacity shall be available to replace the largest unit during shut-downs.

(v) Chemical feed equipment shall be located in a separate room to reduce hazards and dust problems; shall be conveniently located near points of application to minimize length of feed lines; and, shall be readily accessible for servicing, repair, and observation of operation.

(vi) Feeders shall be able to supply, at all times, the necessary amount of chemicals at an accurate rate.

(b) Control

(i) Feeders with automatic controls shall be designed so as to allow override by manual controls.

(ii) Chemical feed rates shall be proportional to flow.

(iii) Meters, scales, calibration columns, or other acceptable means to measure chemicals being fed must be provided in order to determine chemical feed rates.

(iv) Provisions shall be made for measuring the quantities of chemicals used.

(c) Cross-connection control

(i) Cross connection control shall be provided to ensure that liquid chemical solutions cannot be siphoned through solution feeders into the water supply.

(ii) The service water lines discharging to the solution tanks shall be properly protected from backflow as required by the Department.

(iii) No direct connection shall exist between any sewer and a drain or overflow from the feeder, solution chamber or tank. All drains shall terminate at least six (6) inches or two (2) pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle.

(d) Service Water Supply - Service water supply shall be ample in supply and adequate in pressure; shall be properly treated potable water; shall be properly protected against backflow; and, a means shall be provided to measure the quantity of water used in preparing specific solution concentrations by dilution;.

(e) Storage of chemicals

(i) Space shall be provided for at least thirty (30) days of chemical supply and provide for convenient, efficient and safe handling of chemicals. Dry storage conditions must be maintained for dry chemicals.

(ii) Storage tanks and pipelines for liquid chemicals shall be designed specifically for each chemical used.

(iii) Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved covered storage unit.

(iv) Liquid chemical storage tanks shall have:

(A) a liquid level indicator;

(B) an overflow; and,

(C) secondary containment capable of receiving and containing accidental spills or overflows. Consideration must be given to reactivity of chemicals stored in a single containment area.

(f) Solution tanks

(i) A means which is consistent with the nature of the chemical solution shall be provided in a solution tank to maintain a uniform strength of solution. Continuous agitation shall be provided to maintain slurries in suspension.

(ii) Two solution tanks of adequate volume may be required for a chemical to ensure continuity of supply in servicing a solution tank.

(iii) Means shall be provided to measure the solution level in the tank.

(iv) Chemical solutions shall be kept covered. Large tanks with access openings shall have such openings curbed and fitted with tight overhanging covers.

(v) Surface locations for solution tanks shall:

(A) be free from sources of possible contamination; and,

(B) ensure positive drainage from ground waters, accumulated water, chemical spills and overflows from around tank.

(vi) Overflow pipes, when provided, shall:

(A) be turned downward, with the end screened;

(B) have an air gap of two (2) pipe diameters or six (6) inches, whichever is greater; and,

(C) be located where noticeable.

(vii) Acid storage tanks shall be independently vented to the outside atmosphere.

(viii) Each tank shall be provided with a valved drain, protected against backflow in accordance with R.61-58.3(E)(2)(c)(iii).

(ix) Solution tanks shall be provided with protective curbing, drains or other secondary containment capable of receiving and containing accidental spills or overflows.

(g) Day tanks

(i) Day tanks shall be provided where bulk storage of liquid chemical is provided.

(ii) Day tanks shall meet all the requirements of R.61-58.3.E(2)(f).

(iii) Day tanks shall be scale-mounted, or have a calibrated gauge painted or mounted on the side so liquid level can be observed in a gauge tube or through translucent sidewalls of the tank. In opaque tanks, a gauge rod extending above a reference point at the top of the tank, attached to a float may be used. The ratio of the area of the tank to its height shall be such that unit readings are meaningful in relation to the total amount of chemical fed during a day.

(iv) Hand pumps may be provided for transfer from a carboy or drum. A tip rack may be used to permit withdrawal into a bucket from a spigot. Where motor-driven transfer pumps are provided, a liquid level limit switch and an overflow from the day tank, which will drain back into the bulk storage tank or other approved location, shall be provided.

(v) Tanks shall be properly labeled to designate the chemical contained.

(h) Feed lines

(i) Feed lines shall be as short as possible in length of run, and of durable, corrosion resistant material. They shall be easily accessible throughout the entire length, protected against freezing, and readily cleanable.

(ii) Feed lines shall be designed consistent with scale-forming or solids depositing properties of the water, chemical, solution or mixture conveyed.

(iii) Feed lines shall be color coded and labeled .

(iv) Where lime is added, a spare feed line equal in length to the longest run of feed line, shall be provided.

(i) Handling

(i) Carts, elevators and other appropriate means shall be provided for lifting chemical containers.

(ii) Provisions shall be made for disposing of empty bags, drums or barrels by an approved procedure which will minimize exposure to dust.

(iii) Provision shall be made for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers, in such a way as to minimize the quantity of dust which may enter the room in which the equipment is installed.

(iv) Provision shall be made for measuring quantities of chemicals used to prepare feed solutions.

(j) Housing

(i) Floor surfaces shall be smooth, impervious, slip-proof and well-drained.

(ii) Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes.

(iii) Feeders used in conjunction with dry lime or carbon shall be housed in separate, individual rooms equipped with dust control systems.

(iv) Sufficient lighting for operator safety and sufficient heating to provide for proper operation of the chemical feed equipment shall be provided for all chemical feed rooms.

(3) Chemicals Specifications - All chemicals and products added to a public water supply as part of the treatment process shall be certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation Standard 60, Drinking Water Treatment Chemicals - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

F. Waste Handling and Disposal.

Waste handling and disposal practices shall meet all applicable rules and regulations of the Department. Provisions must be made for proper disposal of water treatment plant waste such as sanitary, laboratory, clarification sludge, softening sludge, iron sludge, filter backwash water, filter to waste, and brine waste. In locating waste disposal facilities, due consideration shall be given to preventing potential contamination of the water supply. For projects involving a surface water discharge of water treatment residuals or waste water, a National Pollutant Discharge Elimination System (NPDES) permit must be obtained from the Department. For projects involving land application of water treatment residuals or waste water, a No Discharge (ND) permit must be obtained from the Department.

(1) Sanitary Waste - The sanitary waste from water treatment plants, pumping stations, etc., must receive treatment. Waste from these facilities must be discharged directly to a sanitary sewer system, when feasible, or to an adequate on-site waste treatment facility.

(2) Alum Sludge - Mechanical concentration or lagooning may be used as a method of handling alum sludge. Acid treatment of sludge for alum recovery may be a possible alternative. Alum sludge can be discharged to a sanitary sewer only if acceptable to the receiving sewer system and approved by the Department before final designs are made.

(a) Lagoons shall be designed to meet the following requirements:

(i) A minimum of two (2) lagoons are required for handling alum sludge.

(ii) The location shall be such that the top of the dike is at least one (1) foot above the one hundred (100) year flood plain;

(iii) Where necessary, dikes, deflecting gutters or other means of diverting surface water runoff shall be provided so that it does not flow into the lagoon;

(iv) A minimum usable depth of five (5) feet with adequate freeboard shall be provided so as not to interfere with normal plant operation;

(v) Dikes shall be constructed of relatively impervious material and compacted to at least ninety (90) percent Standard Proctor Density to form a stable structure. Vegetation and other unsuitable materials shall be removed. Minimum dike width shall be eight (8) feet. Dike slopes shall not be steeper than one (1) foot vertical to three (3) feet horizontal;

(vi) A minimum separation of four (4) feet between the bottom of the lagoon and the maximum groundwater elevation shall be maintained;

(vii) A synthetic liner of at least twenty (20) mil (0.20 inches) thickness or a natural liner consisting of one foot of compacted clay having a hydraulic conductivity (coefficient of permeability) of no more than .0000001 centimeters per second shall be used;

(viii) A monitoring system shall be constructed to measure the water quality in the upper most aquifer. One (1) upgradient monitoring well and an adequate number of down gradient monitoring wells, so as to fully define any potential leacheate plume, shall be provided;

(ix) An adjustable decanting device must be provided;

(x) Effluent sampling point and flow measurement device must be provided;

(xi) Erosion control through grassing, rip-rap, or other means is required on both the inside and outside dike surfaces; and,

(xii) Adequate safety provisions must be installed.

(b) Mechanical concentration or de-watering - A pilot study is required before the design of a mechanical de-watering installation. Provisions shall be made for holding basins so as to maintain continuity of service of the water plant. Vacuum filters, centri- fuges, filter presses, belt presses, or other devices will be considered.

(3) Lime softening sludge - Methods of treatment and disposal are as follows:

(a) Lagoons

(i) Temporary lagoons which must be cleaned periodically shall be designed on the basis of seven tenths (0.7) acres per million gallons per day per one hundred (100) milligrams per liter of hardness removed based on a usable lagoon depth of five (5) feet. At least two (2) lagoons must be provided in order to give flexibility in operation. An acceptable means of final sludge disposal must be provided. Provisions must be made for convenient cleaning.

(ii) Permanent lagoons shall have a volume of at least four (4) times that for temporary lagoons.

(iii) The design of both temporary lagoons and permanent lagoons shall meet the requirements for lagoons in paragraph 2(a) above.

(b) Discharge of lime sludge to sanitary sewers shall be avoided if possible since it may cause both liquid volume and sludge volume problems at the sewage treatment plant. This method shall be used only when the sewer system has the capability to adequately handle the lime sludge and is acceptable to both the sewer system and the Department.

(c) Mechanical de-watering of sludge may be considered. Pilot studies on a particular plant waste are required.

(d) Calcination of sludge may be considered. Pilot studies on a particular plant waste are required.